Review Article

Six Sigma Methodology for Analysing & Removing Defects in Plastic Moulding by Injection Moulding Machine

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Abstract

This thesis is all about Six Sigma methodology. Six Sigma is step by step improving technique for a business growth or to create a new business idea. Six Sigma has two methodology but in this thesis DMAIC methodology was considered because DMAIC methodology is used to improve the existing business operation while other methodology is used to create new aims or goals or new product design. In this thesis DMAIC is used in which first the problem of a company is defined by carrying few interview at the company after that the rejection data was asked. The provided data was measured and thoroughly analyzed for rectifying the main defect and the main root cause for that defect. After identifying & Analyzing the defect and the defect cause as well, the improvising state starts. Few Measures were suggested to minimize the defects also few control actions were suggested to ensure that the quality of product should be maintain and to ensure that all corrective measures were following up regularly.

This thesis was done on Injection moulding machine in a factory of Nexus Telecom Private limited located at Chhatarpur, New Delhi. Mentioned Injection moulding machine is used for plastic moulding on RF jumpers used in telecom towers. Objective of this case study was to rectify defect and to suggest corrective measures to minimize those defects occurring in plastic moulding on products. The main defect occurring was crack in moulding & dark black spot in moulding. Barrel & screw were cleaned to increase surface finish of plastic moulding and some training programs were also suggested for the technicians using that machine for moulding.

Keywords: Black spot, Six Sigma, Injection Moulding

Literature Review

These days, Six Sigma has been broadly received in an assortment of businesses on the planet and it has turned out to be a standout amongst the most vital subjects of open deliberation in quality administration. Six Sigma is a very much organized philosophy that can help an organization accomplish expected objective through nonstop venture change. A few difficulties, in any case, have risen with the execution of the Six Sigma. The advancement a novel way to deal with make basic Six Sigma extends and recognize the need of any ventures.

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Firstly, the projects are created from two aspects, namely, organization's business strategic policies and voice of customer. Secondly, an analytic hierarchy process (AHP) model is implemented to evaluate the benefits of each project and; a hierarchical failure mode effects analysis (FMEA) is also developed to evaluate the risk of each project; and from which the priority of Six Sigma projects can be determined.

At last, in view of the venture advantages and hazard, activities can be characterized as Green Belt, Black Belt, or others writes of undertakings. An observational contextual analysis of semiconductor foundry was used to investigate the adequacy of this approach. The money saving advantage examination is critical, particularly for organizations whose items have a little net revenue. Specialists are experiencing and two advancement models are suggested that will help administration to pick prepare change openings. These models consider a multi-arrange, offbeat assembling process with the chance to enhance quality (piece and adjust rates) at each of the stages.

The principal model is to boost the sigma quality level of a procedure under cost requirement while the determination of Six Sigma other options to augment handle returns is considered by the second model. The vital criteria are assessed by the administration group utilizing a Delphi fuzzy different criteria basic leadership technique. At that point, the strategic sub-criteria which contain extra operational issues are assessed by the Six-Sigma Champion. Execution of the DMAIC (Define, Measurement, Analyse, Improve, and Control) based Six Sigma approach keeping in mind the end goal to enhance the spiral fashioning operation factors. In this examination, the creators have kept their prime concentrate on limiting the residual stress created in parts made by the spiral producing process. Notwithstanding the inescapability of Six Sigma program usage, there is expanding worry about execution disappointments. One reason numerous Six Sigma programs come up short is because a usage demonstrate on the most proficient method to successfully control the execution of these projects is deficient.

Utilizing a fruitful Six Sigma program in a Network Technology organization, the reason for this exploration is to build up a successful execution demonstrate which comprises of six stages. The initial step is to perform key examination driven by the market and the client. The second step is to build up an abnormal state, cross-utilitarian group to drive the change activity. The third step is to distinguish overall improvement tools. The fourth step is to perform high-level process mapping and to prioritize improvement opportunities. The fifth step is to develop a detailed plan for low-level improvement teams, and the sixth step is to implement, document, and revise as needed. Important for both practitioners and academicians, implications of our implementation experience along with directions for future research are provided.

Based on literature review, this research aims at

1. To utilize six sigma methodology in performing the study.
2. To study the "Black dot" rejects utilizing QC tools at the identified production lines.
3. To identify the root causes of the "Black dot" rejects.
4. To recommend actions to improve the Black dot rejects and Sigma level.

Injection Moulding Process

Injection Molding is an assembling method for making parts from thermoplastic material underway. Molten plastic is infused at high pressure into a mould, which is the inverse of the item's shape. Injection Molding machines, otherwise called presses, hold the molds in which the segments are formed. Presses are evaluated by tonnage, which communicates the measure of clamping force that the machine can produce. The process of injection cycle is as per the following: Mold closes-injection carriage forward infuses plastic-metering-carriage withdraw-Mold open-discharge part. The molds are shut closed by water power or electric, and the heated plastic is constrained by the pressure of the injection screw to take the state of the shape. The water-cooling channels then help with cooling the Mold and the warmed plastic hardens into the part. Inappropriate cooling can bring about twisted trim or one that is scorched. The cycles get finished at the point when the Mold opens and the part is shot out with the help of ejector sticks inside the Mold. The pitch, or crude material for injection trim, is as a rule in pellet or granule frame, and is liquefied by warmth and shearing force without further ado before being injected into the shape. Gum pellets are filled the sustain container, an expansive open bottomed holder, which bolsters the granules down to the screw. The screw is turned by an engine, nourishing pellets up the screw's scores. The profundity of the screw flights diminishes towards the finish of the screw closest the shape, compacting the warmed plastic. As the screw turns, the pellets are advanced in the screw and they experience outrageous pressure and friction which creates the clear majority of the heat expected to liquefy the pellets. Warmers on either side of the fasten help the warming and

temperature control amid the softening procedure. The channels through which the plastic streams toward the chamber will likewise cement, shaping a joined casing. This casing is made from the sprue, which is the fundamental channel from the supply of liquid gum, parallel with the course of draw, what's more, runners, which are opposite to the course of draw, and are utilized to pass on liquid pitch to the gate(s), or point(s) of injection. The sprue and runner framework can be cut or turned off and reused, now and again being granulated alongside the shape machine. A few molds are planned so that the part is naturally stripped through activity of the form.

A Case Study

The application of Six-Sigma methodology is a statistical analysis approach to quality management. In this approach, the rejection ratio of 30-tone injection Moulding production department in a company Nexus Telecom, New Delhi was analysed statistically using DMAIC methodology and suggestions for quality improvement will be made to the department.

Six Sigma Methodology For Analysing & Removing Defects In Plastic Moulding By Injection Moulding Machine

The application of Six-Sigma methodology is a step by step approach to quality management and therefore DMAIC methodology is used to improve quality in injection moulding process.

Define Stage

Prior to the procedure can be examined, all conditions must be characterized. Such conditions are frequently depicted as SIPOC (Suppliers, Inputs, Process, Outputs and Clients)

- Suppliers -Material supplier, Reliance polymers
- Inputs -Material, LDP 16M400, Masterbatch
- Process -Receive LDP 16M400 and load into hopper
  - -Feed LDP 16M400 into moulding machine
  - -Mould cover
  - -Deliver cover to assembly stations
- Outputs -Cover
- Customers -End customers

Pareto Chart for Defect Rejection

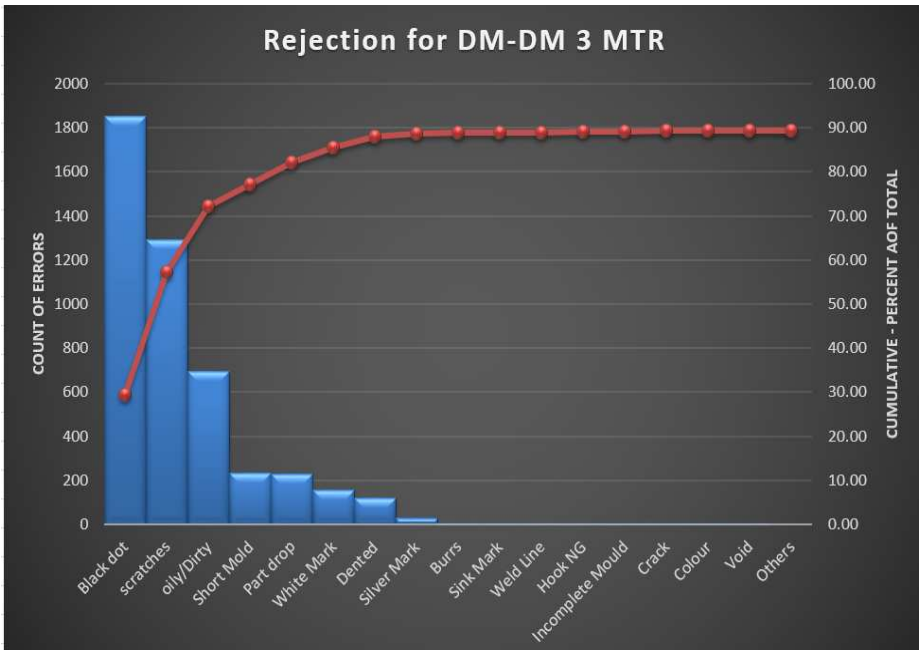
Measure Stage

In measure stage the deformities per million opportunities (DPMO) is computed measure to help screen advance towards the venture objectives. Client desires are characterized to decide "out of specifications" conditions.

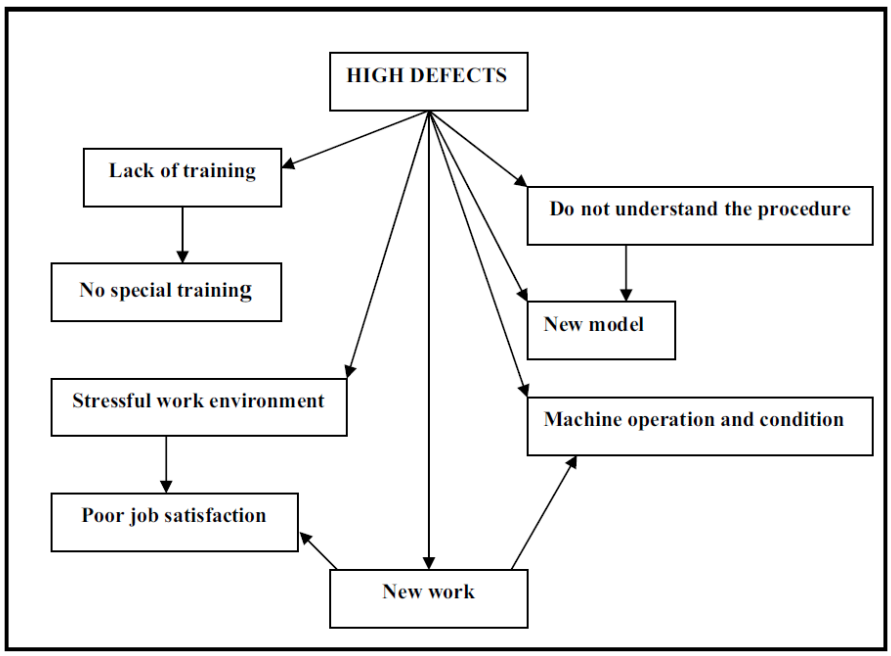
Analyse Stage

In analyse stage the root cause of the Black Dot defect is figured out in the product being manufactured which is generally due to five major components which includes machine, environment, operator, method and the material. Data collected for previous months & analysed. Black dot defect was found common in manufacturing. Machines are one of the components that must be given Black Dot thought. The machine

contributes a considerable measure to Black Dot rejection defect. Examples, without proper data feeding, it will result to a carbonized screw. Aging machines also can lead to defects. Maintenance also plays an important role because, without maintenance, the performance of machine will be affected and the desired output could not have been gained. When an operator does not have enough experience and practice, it is obvious that the operator produces more defects than the others. Defects might occur when jobs carried out without proper guidance of Expertise or without any instruction. Besides that, number of defect will increase when untrained administrator or new administrator are assigned to do the job. The work method is another major cause of the problem. It was found that the operator did not know the correct method set the machine and the parameters but only followed the instructions without knowing the correct method. As a result, the administrator may lead to black dot defect or other rejection. Besides that, a material is an important medium in injection moulding process that contributes to some major defects. Examples, when material is sullied with other remote particles it will influence the properties of the part and at the same time it leads to major defects.



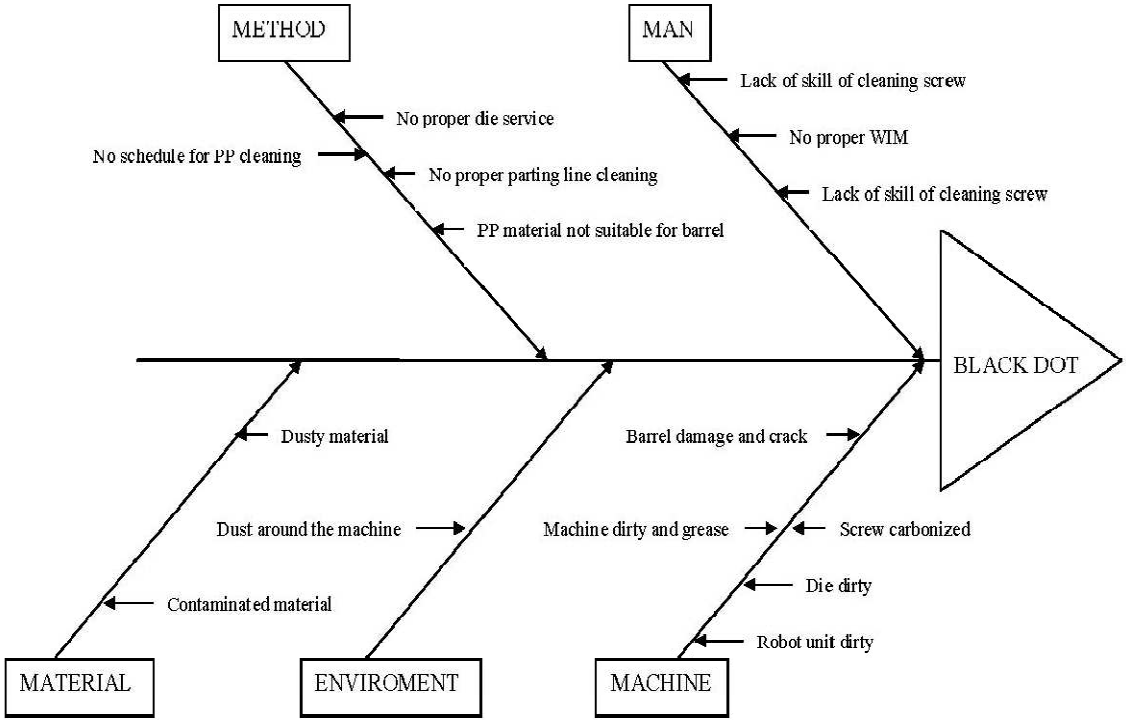
Pareto Chart for DM-DM 3 MTR defects



Potential Causes for High Defects

Some Other Factors Are-Defected Barrel Or Screw- A damaged injection cylinder or rough screw is a cause of material hang-up and degradation. Ultimately this degraded material breaks, loose and enters the melt stream, appearing as Dot

Contamination from Lubricants: Excessive use of mould release will clog vents. The trapped air cannot be evacuated and burns. Also, grease that is used for lubricating cams, slides, ejector pins, etc., can seep into the mould cavity and contaminate the moulded part.



Root Cause Analysis for Black Dot

Improve Stage

In the wake of gathering and investigating the information proposal is prescribed to decrease the imperfection. Furthermore, the proposals are to clean Barrel and utilization of cleaning agent for cleaning Screw and Barrel Screw.

Limit Downtime And Reduce Scrap- Special Material is cleaned on the main pass, limiting machine downtime to augment the efficiency. This moreover decreases scrap so don't waste resin.

Economical- Only a little measure of material is expected to cleanse rapidly and viably. It has boundless life.

Safe To Use- Special material is non-synthetic/no-unsafe and no rough. It doesn't bring about wear on machines. It is alright for machines and operators and safe for disposal. In view of the recommendation given, the dismissal rate can be diminished and at the same time the sigma level can be moved forward.

Control Stage

Control stage is most important stage before finalizing DMAIC methodologies.

This stage will elaborate the step taken to control. One of the common types of quality tool used is the control chart.

Sigma level is calculated as

Z =0.8406+'{29.37-2.2211n(DPMO)}

Where, DPMO= DPU/CTQ*106,

DPU= defect per unit =Rejection/Total pieces,

CTQ=critical to quality.... through SIPCO (supplier, input, process, customer, output)

Result and Discussion

DMAIC method of Six Sigma was implemented considering four machines. It s hows that the highest rejection rate was identified in the month of Nov (2016). Thus, lowest sigma level i.e. 4.2420 was recorded for

the month of Nov whereas the highest being 4.2486 for Apr. The study is focussed for Nov. Further, Machine E03 has higher rejections due to black dot. Thus, this machine will be required for analysing the root cause.

Conclusion

Some actions are suggested for future.

- Clean Barrel and utilize cleaning operator for cleaning Screw and Barrel.
- Sand paper can also be utilized as mainly the dirt was identified from the material was carbonized because overheating of barrel. The overheated material will remain on the screw and will release slowly each time of injection which results the black dot on the surface.

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